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# agricultural research

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## Elemental Stirrings

In the deepening cold but steadily gaining light of January house-bound gardeners are welcoming the arrival of new seed catalogs. What better way to spend a quiet evening than by an open fire savoring the hundreds of offerings extolled in their magnificently illustrated pages? Along with renewed anticipation it is time again to make plans and order seeds for the growing year.

But if seed catalogs are designed to provoke activity they also bestir reveries, for gardening by its very nature has a contemplative side. There is time for work, reflection, and the making of memories as garden life pulses to the mystery of green, sometimes pressing on, sometimes pausing in response to the rhythms of the seasons. As every gardener knows, paging through a seed catalog can be most evocative of gardens past.

The thoughtful gardener finds satisfaction in remembering that life-harboring seeds fulfill their eternal promise to yield fruits, vegetables, and flowers—gifts that nourish our bodies and souls. At seed time, especially, he feels an intuitive kinship with ancient forebears whose lives meshed with the fundamental cycles and forces of nature. Modern man, however, has largely lost touch with elemental realities.

Modern man needs to preserve his connections with his ancestral past. Through reestablishing some contact with nature, urban man can relieve his loneliness, the sense of spiritual isolation that has plagued him since he severed ties with the natural world that sustained him over the centuries.

Gardening fosters another benefit. In our increasingly rootless urban society, gardening can help instill a much needed sense of place. This can come from caring for one's own piece of earth, whether it be farflung acres or the humblest of garden plots. When we cherish our gardens, we are really caring for all the countryside around us, an attitude, incidentally, that is fundamental to developing an ecological conscience.

Today's emphasis on ecology is a healthy one. More people need to know that we live because of plants. It is the green leaf, powered by sunlight, that through photosynthesis turns carbon dioxide and water into the oxygen and sugars that ultimately sustain all life. In our urbanized society, gardening can help us appreciate this fundamental fact.

For those who till and tend the green kingdom there is healing balm and values that enrich man's inner and intangible being. They are among the promises that the contemplative gardener finds in the rustle of the catalog's pages as he awaits the rewards that mount with a warming sun.

## ENVIRONMENT

- 8 Recover, recycle, reuse

## INSECTS

- 13 Turning the tide on pests

## MARKET QUALITY

- 6 Mechanized potato bagging?  
12 A discount for moisture

## NUTRITION

- 7 Another source of protein

## PLANT SCIENCE

- 3 Early flowering fruit trees  
5 Controlling wheat rust  
14 Water curbs weeds in rice

## UTILIZATION

- 14 Quiet fans remove fibers

## AGRISEARCH NOTES

- 15 Beef from bulls?  
15 Don't spoil the dates  
15 Luring the codling moth  
16 Long live the daisy

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**COVER:** This simple test demonstrates the digestive ability of enzymes. In this study ARS scientists immersed the filter paper on the left in plain water; the other filter paper in fiber-digesting enzymes. Within 15 minutes the enzymes broke the filter paper into short fibers—precursors of simple sugar. In other tests, scientists are adding the enzyme to chicken feed to improve its digestibility, 1072X1395-14). See story p. 8.

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**Earl L. Butz, Secretary**  
**U.S. Department of Agriculture**

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*Dr. Zimmerman—shown here studying flower development on a crabapple seedling—hopes to determine at what stage of development an internal change takes place which permits flowers to be formed. Recent evidence tends to indicate that a change in growth hormones, in both amount and balance, controls flowering (0872W1206-16).*

## Early flowering fruit trees

**A** NEW WAY to produce flowering in crabapples in less than a year from germination of the seedlings may hasten development of new varieties of related pome fruits and other slow-maturing trees.

Fruit trees often take 10 years for one generation to reach maturity. Moreover, scientists require a span of 20–30 years—representing several generations—to incorporate disease resistance into these crops. Thus, genetic study and breeding of new fruit tree varieties is a costly and slow process. In contrast, crops such as corn, wheat, or barley, may produce two generations in a year.

Crabapples usually produce flowers only after the plants are 3 or 4 years old. In greenhouse experiments at Beltsville, Md., plant physiologist Richard H. Zimmerman induced seedlings of genetic uniformity to flower in 7 to 10 months. His findings are expected to be directly applicable also to such other pome fruits as apples and pears.

Dr. Zimmerman induced early flowering by a combination of treatments. He exposed the plants to long days—16 hours of artificial light or longer. He also held the plants under a controlled temperature of 64° to 77° F. Fertilizer was applied weekly or biweekly.

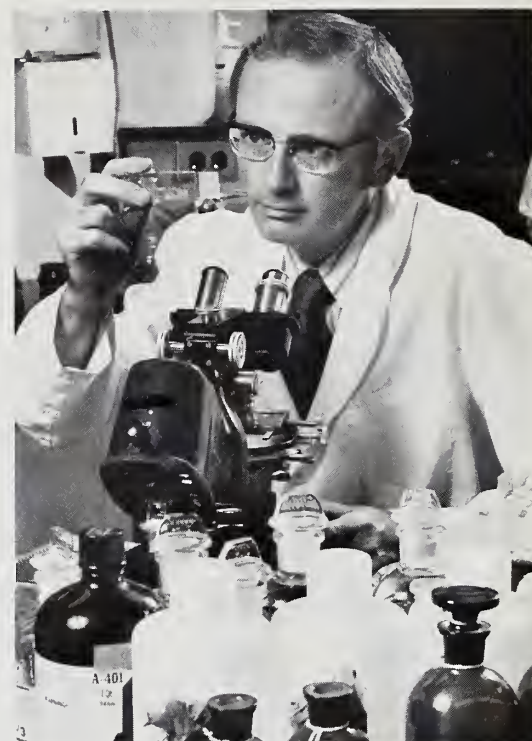


Within 10 months, the seedlings grew 6 to 9 feet. They produced 75 or more nodes—a critical factor in inducing flowering. At this point in the plants' growth, he applied chemical growth regulators or cold treatments to stimulate flowering. Such treatments proved effective only on plants having 75 nodes or more.

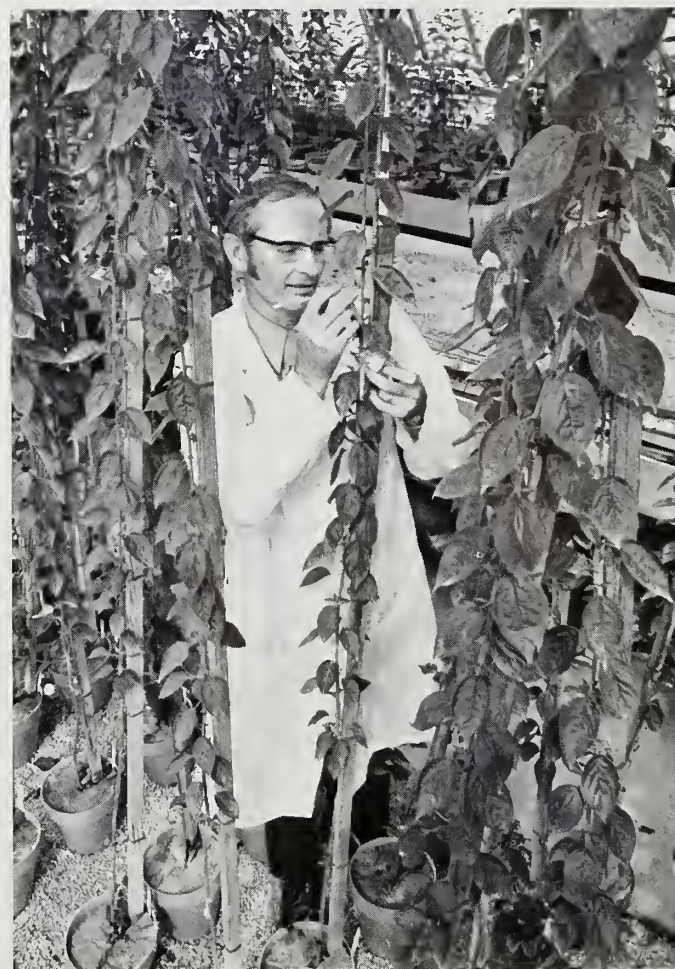
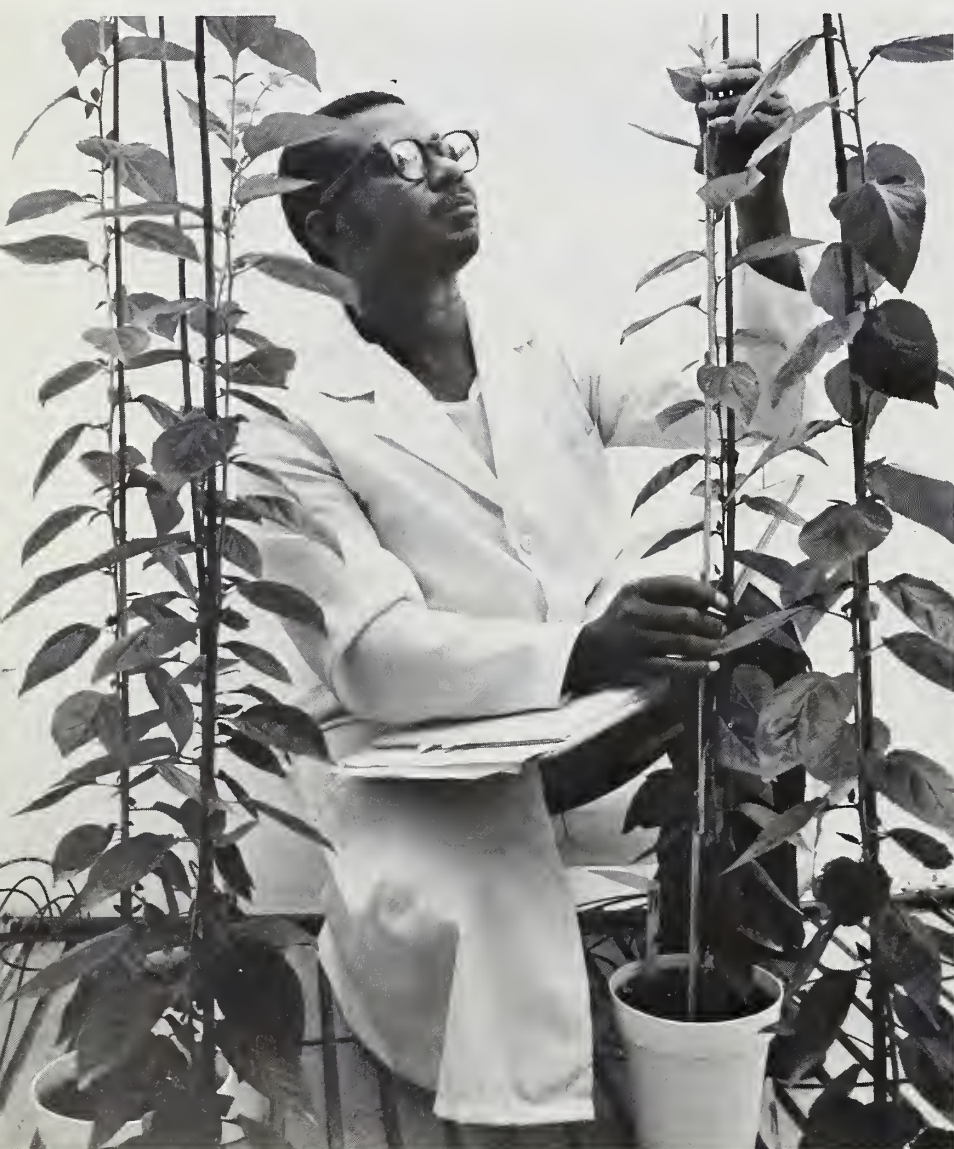
In practical application, first-year flowering might be obtained with nursery stock or large-scale test lots of seedlings by modifying the experimental procedures. Seedlings could be grown in the greenhouse for about 2 months to promote rapid growth—2 to 4 feet. During this period, they could

be quickly screened for disease and insect resistance, with the most promising plants then transplanted in the field. This procedure would permit the growing of more plants in the greenhouse, yet stimulate sufficient growth to achieve flowering by the second or third season, as compared to 6 to 10 years under normal conditions.

Growth regulators have been used to induce flowering in mature plants. Dr. Zimmerman will conduct further studies to see if they will also be effective when the plants have reached the transitional phase between nonflowering juvenile growth and sexual maturity. □



*Above: Dr. Zimmerman examines stained sections of buds to identify the earliest stages of flower bud initiation (1072W1327-17). Below left: In growth chamber experiments with flowering crabapple seedlings, greenhouse aide Richard Ferebee records plant height and number of nodes (1072W1328-17). Below right: Dr. Zimmerman treats 9-foot-tall crabapple seedlings with growth regulators in research aimed at producing flowering in this and other pome fruits in less than a year from germination (0872W1206-3).*





## Controlling wheat rust from the inside

NEW systemic fungicides may be the key to prevention of severe disease epidemics in field crops threatened by virulent, aggressive forms of plant diseases.

In ARS studies, newly developed fungicides acting within the host plant are giving full-season control of rust diseases of spring wheat with only one or two applications at low rates. These fungicides generally have selective toxicity against specific disease organisms.

Available fungicides applied to plant surfaces as protectants may provide partial control of leaf rust and other leaf spot diseases. Their usefulness is limited, however, by difficulty in timing applications accurately, incomplete coverage of plants by aerial spraying, and rapid removal of the protective coating by rain.

Resistant and early maturing wheat varieties are the major defense against crop losses from wheat rusts. But the resistance of a widely planted variety has been repeatedly breached by the

appearance of a new, virulent form of the disease organism. The outbreak of the 15B race of stem rust caused losses to spring wheat growers estimated at \$410 million in the 1950's. Effective and economical fungicide controls could suppress severe epidemics while new resistant varieties are being developed and distributed.

ARS plant pathologist John B. Rowell, Cereal Rust Laboratory in St. Paul, Minn., has been investigating the potential of fungicides for control of leaf and stem rusts of wheat since 1955. In cooperation with the Minnesota Agricultural Experiment Station, Dr. Rowell is seeking the ideal material—one that will suppress an epidemic and reduce losses with a single treatment at a low application rate. Some of the new systemics he is testing approach this goal.

The most promising is 4-*n*-butyl-1,2,4-triazole, so specific in its action that it is effective only against leaf rust of wheat. Moreover, it is effective at ex-

tremely low application rates. A few micrograms added to the soil in a 4-inch pot will protect seedlings against leaf rust infection.

In field tests, Dr. Rowell has obtained effective control of the disease with a spray application of the fungicide at only 2 ounces per acre, put on 3 weeks after the wheat was planted. The systemic also controlled leaf rust in experimental plots for 80 to 90 days when used as a seed treatment at rates up to 2 ounces per hundredweight. Dr. Rowell says this material shows great promise as a simple means of controlling leaf rust on spring wheat.

In continuing research, he is seeking a similarly effective systemic fungicide for controlling stem rust of wheat. Two other experimental materials show promise against both leaf and stem rust.

Triarimol (*α*-(2,4-dichlorophenyl)-*α*-phenyl-5-pyrimidinemethanol) has given good control of both diseases with two applications at 8 ounces per acre, but was less effective at 2 ounces per acre. Two applications of *α*-(2-chlorophenyl)-*α*-cyclohexyl-5-pyrimidinemethanol equaled triarimol against leaf rust and gave better control of stem rust. Further tests are needed to determine the optimum rates and application time.

None of these fungicides are registered by the Federal Government for use on wheat. Before registration, rigorous testing must assure that they are free of undesirable effects in animals or man, that they deteriorate without objectionable residues in the environment, and that they do not adversely affect the biosphere.

As long as field crops are threatened by destructive disease epidemics, there will be a need for fungicides to avert disaster. New systemic fungicides promise to fulfill this need. □

# Mechanized potato bagging?

POTATOES can be bagged and the bags sewn shut by machines without sacrificing market quality or incurring significant physical damage.

Mechanizing food handling methods increases efficiency while reducing physical damage, hence a less expensive, higher quality produce is placed on the market. Accordingly, several potato packing sheds in California have installed machine fillers and machine closers for bagged potatoes. The 100-pound burlap bags used for this process are somewhat larger than conventional ones, which are packed manually and closed by hand sewing.

But employing machine-filled and sewn bags worried many potato packers. The larger bag size permits tubers to move about more within the bags during transit. Such movement would cause physical damage to the tubers. Also, the larger size allows bags to "relax" more when loaded in the railcar, filling more voids in the load, and possibly affecting air movement which in turn would affect transit temperature—a key factor in preserving potato quality.

To alleviate these apprehensions, horticulturist Joseph K. Stewart, Fresno, Calif., and plant pathologist Jacob Kaufman, Belle Mead, N.J., both of ARS, compared the two handling methods in shipping tests from Kern County, Calif., to Jersey City, N.J.

The scientists shipped eight test cars, loading half of each test car with 300 machine-filled and sewn bags, the other half with 300 hand-sewn bags. All bags were loaded and placed conventionally

with hand-sewn bags stacked at the car's engine end in four cars and at the brake end in the remaining four cars.

Thermometers, placed in potato bags at strategic places in each car recorded load and inside air temperatures. The scientists also measured carbon dioxide and oxygen levels in the cars at destination, and evaluated sample bags for product quality.

Test results show transit temperatures are essentially the same in both hand-sewn and machine-sewn containers. During the tests, average individual load transit temperatures ranged from 45° to 52° F. for hand-sewn bags and 44° to 54° F. for machine-sewn bags. All thermostat settings were 42° F.

In general, accumulation of respiratory carbon dioxide is not excessively high. Potato quality does not appear to be affected by the rail car carbon dioxide levels which accrue in transit. Oxygen levels are not low enough to affect the potatoes either.

The crucial question on potato market quality under the new handling conditions has been answered. Potatoes shipped in the two types of bags did not differ significantly in moderate or severe cutting or crushing, in bruising, internal blackspot, browning, or soft rot.

Since mechanized and manual potato handling provide equal product quality, potato packers can decide which bag and which system to use on the basis of economic factors and the compatibility of the handling system with their own operations. □



**P**ROTEIN from cottonseed will soon begin to reach dinner tables at home and perhaps abroad as a result of a newly developed process now ready for commercial use.

Besides making another edible protein source available domestically, the process could play a major role in increasing protein in underdeveloped countries that grow cotton.

Called the Liquid-Cyclone-Process (LCP), it will become available commercially this year when the Plains Cooperative Oil Mill begins operations in its new 25-ton-per-day cottonseed flour plant in Lubbock, Tex.

Numerous pilot plant runs at the ARS Southern research laboratory, New Orleans, where the process was developed, indicate that each 100 tons of cottonseed should yield about 25,000 pounds of high-quality edible flour containing about 65-percent protein. Thus, the potential is for the United States to produce about 500,000 tons of such flour annually, the rest of the world perhaps 2 million tons or more. The product could make a major contribution toward easing the global problem of protein malnutrition.

The new process involves the mechanical separation into two fractions of specially ground cottonseed kernels in a hexane slurry.

Separation is achieved by running the slurry under pressure into a cone-shaped device known as a liquid cyclone. Spinning or whirling the slurry inside the liquid cyclone creates centrifugal forces which throw the heavy meal particles outward and downward to be drawn off the bottom, while the fine particles are forced to the center and upward to be drawn off the top.

The solids in the more desirable overflow fraction drawn off the top contain about 65-percent protein. This fraction,

when finely ground into flour, has a bland flavor and a light creamy color. The underflow fraction, which contains virtually all the gossypol-containing pigment glands, can be sent into conventional cottonseed meal markets such as animal feeds.

LCP flour has been successfully tested in the protein enrichment of wheat flour breads and cookies. Its use as a replacement for 20 percent of the wheat flour in baked goods produced texture and flavor that were judged good. Even more important, the content of protein was raised to 20 to 22 percent, about double that of products made from wheat flour.

Similarly, a commercial biscuit mix that substituted LCP flour for 20 percent of the weight produced biscuits with excellent texture and flavor and a light creamy color. The LCP flour is expected to be equally attractive for making other foods.

Besides fortifying foods low in protein, LCP flour can also serve as a source of three different protein isolates, each with its own performance characteristics.

These three types are: (1) a low

molecular weight "functional" protein isolate, which is high in such nutritionally important amino acids as lysine, cystine, and methionine; (2) a high molecular weight "storage" protein isolate, which is relatively low in lysine and the sulfur amino acids; and (3) a "classical" isolate which is a mixture of both the functional and storage proteins.

The functional protein isolate has a higher protein efficiency ratio than casein, and shows promise as a protein fortifying agent in baked goods and other food products.

The storage protein isolate tends to texturize or form a chewy mass when heated. This characteristic suggests good potential for use in meat products such as wieners and sausages, and in precooked dishes. Normally, it is necessary to use a spinning or extrusion procedure to texturize vegetable protein.

The storage protein isolate also proved to be acid soluble which suggests its use in carbonated, citric-acid-type beverages. A noncarbonated citrus-based punch was fortified with the isolate and proved to be very acceptable in limited taste tests. □

## Another source of protein



***Above:** Before fermentation, feedlot waste is inoculated with the fungus, *Trichoderma viride* by enzymologist Harold Griffin. The fungus grows on fermenting feedlot waste, producing protein and enzymes (1072X1397-1). **Right:** Dry and odorless, fiber isolated from feedlot waste filters through the hands of photo chemist Kenneth Eskins. ARS scientists are using the material in production of fiber board and as a substrate for mold fermentation (1072X1396-12).*







## Recover, Recycle, Reuse

LIVESTOCK and poultry wastes, estimated at more than 1.5 billion tons a year, have become potential sources of pollution. But today's pollutants may become tomorrow's products. Such conversions are the goal of research at the Northern regional research laboratory, Peoria, Ill., supported by contract and cooperative research in Connecticut and Michigan.

Studies are underway on wastes from feedlots and poultry cages, with research emphasis on such diversified products as protein-rich feed for livestock, cellulose for fiber and pulp products, and enzymes to digest fiber. The Peoria research concludes a two-step fractionation process by chemists James H. Sloneker, Richard W. Jones, Harold L. Griffin, Kenneth Eskins, Bernard L. Bucher, and George E. Inglett.

Manure from corn-fed cattle was fractionated by screening and filtering. The chemists believe that if the undigested fiber can be separated from the protein or made more digestible, re-feeding the fractions may be a way to reduce this source of pollution.

A feed fraction obtained in the study weighed 43 percent as much as the dry whole manure and compared with soybean meal in protein content and amino acid balance as determined by chemical analyses. The feed fraction is estimated at about \$60 a ton based on a standard of \$100 a ton for 49-percent protein

soybean meal. Fractionation costs are estimated at only \$40 a ton.

Amino acid analyses of the feed fraction indicated high levels of lysine and methionine and suggested that the protein was produced by micro-organisms in the digestive tracts of the cattle. Microscopic examination supported this suggestion.

Analyses also showed that only 2 percent of the feed fraction was cellulose, which would require further processing for conversion into feed of other products.

A residue fraction, 50 percent of the waste was made into board. The fraction contained cellulose and hemicellulose which the chemists coated with resin in making the board. This experimental board has neither the strength nor the water resistance of commercial hardboard. This residue fraction, however, might be useful for products like fiber planting pots that do not require permanent strength, or it might be blended with other fibers and additives for products like board that require strength and water resistance.

The residue fraction also served as a nutrient for a fungus that produces a fiber-digesting enzyme. The fungus, *Trichoderma viride*, feeds and grows on the fibrous fraction or on the fiber in whole manure, sparing the protein present. The fungal tissue itself is 47 percent protein. The enzyme, used to



treat chicken feed, markedly improved digestibility of the feed. Baby chicks fed enzyme-treated feed ate less, produced less manure, but gained as much weight as did chicks fed two control feeds.

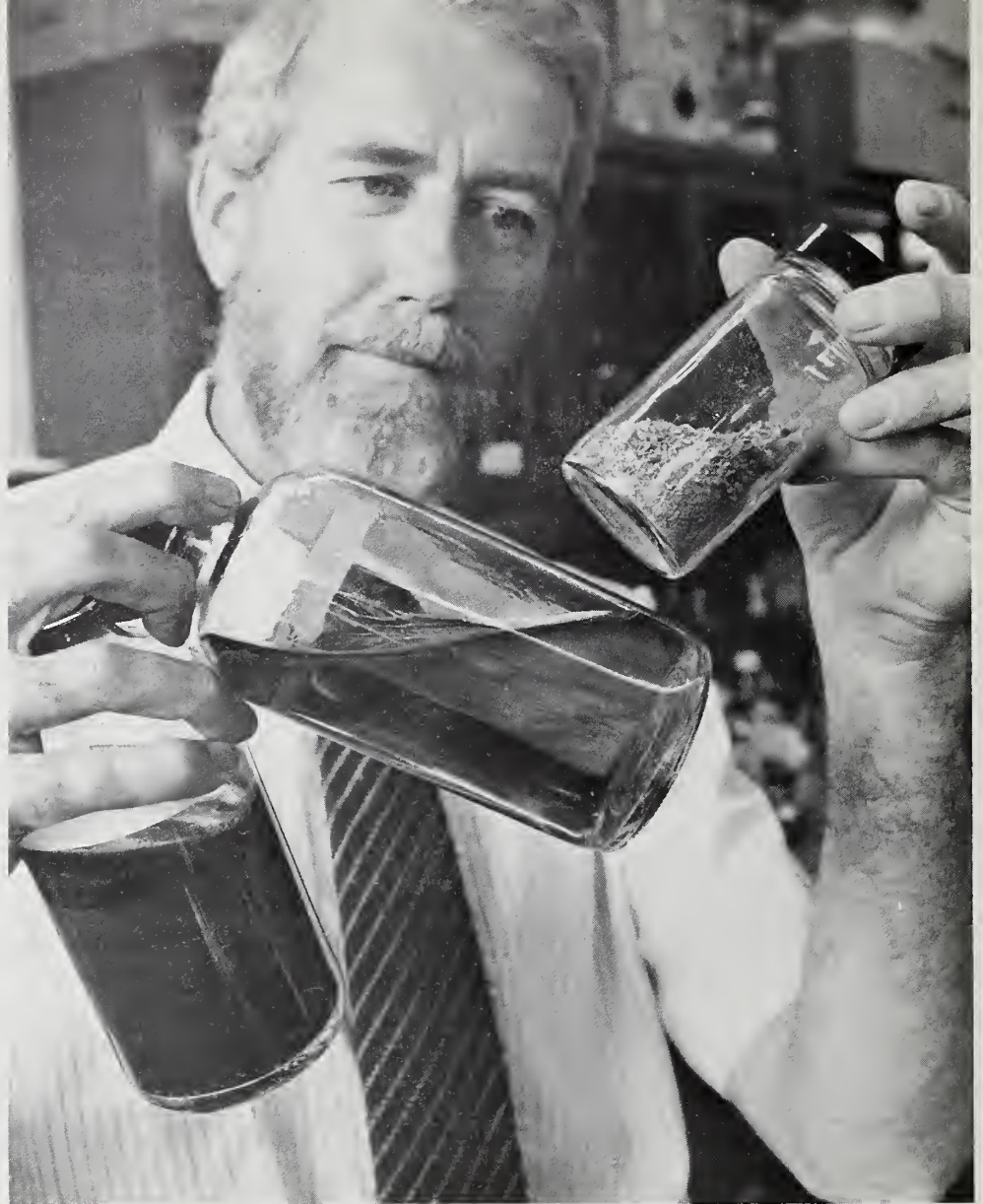
In another study, fiber digestion with enzymes and heat points the way to complete recycling of chicken manure. This study was conducted by Dr. Sloneker, chemist Ben F. Kelson and Michigan State University poultry scientist Cal J. Flegal. Studying compositional changes in recycled chicken manure, Dr. Sloneker, contrary to expectations, found that cellulose and hemicellulose did not build up in waste that was dried and refed as 25 percent of the chick's feed ration through 23 cycles.

Fiber has been considered indigestible by poultry. However, fermentation of the manure and chemical decomposition caused by drying break down the fiber and make it more digestible, Dr. Sloneker explained. These enzymatic and heat-accelerated changes can be improved to permit total recycling with minimum pollution.

In a contract study for ARS by Hamilton Standard of United Aircraft, Windson Locks, Conn., methane fuel gas and protein feed were produced by fermentation of cattle feedlot waste.

Contract reports to Northern laboratory microbiologist, Robert A. Rhodes, showed that cattle feeders with lot capacities ranging between 5,000 and 7,000 head could produce the feed at a cost less than the estimated value. On this scale, methane gas could provide all heat and electric power needed to operate the process.

Amino acid analyses of the feed compared favorably with those of soybean and cottonseed meal. The experimental system operates continuously and has



*Dr. Rhodes observes conversion of liquid fraction in studies of micro-organisms in feedlot waste; center jar holds an odor-free portion of the same liquid after fungal micro-organisms had consumed most of the chemical oxygen demand, rendering it fit for crop irrigation. Top jar contains fungal micro-organisms recovered from fermented liquid waste; scientists are hopeful that this will be suitable as a component in animal feed (1072X1394-14).*

capacity for about 8.5 gallons (10-percent solids) every 6 days. It has been operating about 2 years.

The contract has been extended to find ways to increase yields, improve feeding value of the solid product, and to conduct feeding tests with chicks.

In a study of micro-organisms in feedlot wastes, Dr. Rhodes and microbiologist George H. Hrubant obtained an isolate of *Salmonella*, commonly associated with mild to severe gastrointestinal illness. Although only one pathogen was present among 1,500 isolates, Dr. Rhodes cautions, "indiscriminate

refeeding of understerilized feedlot waste could be hazardous."

Although it's too early to realize the full implications of these studies, ARS scientists can point the way to some process developments and farm practice changes. Developmental research, beyond laboratory results found so far, necessarily would include industrial trials. Further research would also include studies to bring the experimental product or process into conformance with applicable standards of efficiency, health, safety, and environmental protection. □



*At Hamilton Standard, sensitive laboratory gas meters reveal the volume of methane produced by anaerobic fermenters. Mechanical engineer Michael Turk records data. The fermenters generate two-and-one-half cubic feet of methane per day depending on the concentration and loading rate of feedlot waste (1172X1449-6).*



***Right:** Hundreds of micro-organism samples raised in media are analyzed by ARS scientists. Chemist William Orton (left) and micro-biologist George Hrubant are seeking answers to these questions: What micro-organisms are present in feedlot waste? Which can best convert feedlot waste to protein? What is their competitive ability to utilize waste? Which are pathogenic? (1072X-1394-6). **Above:** Fiberboard produced from residue fractions of feedlot waste is examined by photochemist Kenneth Eskins (left) and research chemist James H. Sloneker. A small hydraulic pilot press is used to manufacture the fiberboard (1072X1395-7).*



# A discount for moisture

COUNTRY elevator operators can now allow for the effect of moisture content upon test weight in computing price discounts for newly harvested corn.

The minimum test weight—weight per bushel—for No. 2 corn is 54 pounds. If it is less than 54 pounds, buyers may deduct as much as 1 cent per bushel for each pound below minimum. This deduction is in addition to discounts for low quality and allowance for shrinkage.

Until now, the relationship between moisture content and test weight had not been determined, and it was not taken into account by corn buyers. Related studies by ARS, the Iowa Agriculture and Home Economics Experiment Station, Ames, and the Illinois Agricultural Experiment Station, Urbana, indicate however that the test weight of newly harvested corn increases as moisture content is reduced. For example, corn harvested at 24-percent moisture and dried to 15-percent moisture increased in test weight by 3 pounds. Corn harvested at 20-percent moisture and similarly dried increased by 2 pounds.

The cooperating scientists developed a correction table, showing the increase in test weight at representative moisture percentages, and made it available to Midwest elevator managers before the 1972 corn crop was marketed. When it was used, test weight discounts to farmers were lower and occurred less frequently.

In coordinated studies, five scientists developed the information on which the table is based. ARS agricultural engineer Gerald L. Kline measured test weight changes in corn from four sources—samples newly harvested by corn combines throughout Iowa over

<u>Harvest Moisture Content</u>	<u>Increase in Test Weight</u>
<u>Percent</u>	<u>Pounds Per Bushel</u>
18	1.5
20	2.0
22	2.5
24	3.0
26	3.5
28	4.0

3 years, corn collected from farm and elevator dryers, samples harvested at different stages of maturity, and corn from tests of several bin-drying methods.

Vivan M. Jennings, Iowa extension agronomist, collected data from Iowa Corn Yield Tests involving more than 280 varieties at four locations in northern and central Iowa, and Iowa agricultural economist Marvin E. Martin measured test weight in corn collected at country elevators in 1971. In Illinois, agricultural economist Lowell D. Hill and agricultural engineer Glenn E. Hall determined test weight changes during drying of corn harvested in three seasons and the effect of mechanical damage on test weight.

The correction table is based on normal-quality corn delivered from

corn combines and field shellers. The researchers say that the increase in test weight may be less than that shown in the table for corn with more than 10 percent broken kernels (less than whole kernels); for corn damaged by drought, disease, or weather; for immature corn harvested after a killing frost; and, sometimes, for corn dried at air temperatures of 180° F. or higher.

The adjustment of test weight for moisture applies primarily to the initial transfer of newly harvested corn to country elevators by farmers. The scientists say the adjustment is not used in determining grade under USDA Official Grain Standards for corn. They also point out that test weight at harvest does not affect the legal weight of 56 pounds per bushel used in buying and selling corn. □



**M**AN has swatted, stepped on, squashed, and sprayed insects in an age-old struggle for terrestrial survival, but they continue to plague him.

Despite improved control methods, stored-products insect pests exact an annual toll of millions of dollars. One of the most promising methods to reverse this situation is through pathogenic insect viruses.

ARS entomologist Douglas K. Hunter and laboratory assistants Darlene F. Hoffmann and Susan J. Collier, Fresno, Calif., are studying various viruses that infect the almond moth, webbing clothes moth, potato tuber moth, and Indian meal moth. The researchers are paying particular attention to the host-pathogen relationship, and to the development of techniques for ultimately using these viruses for controlling stored-product insects.

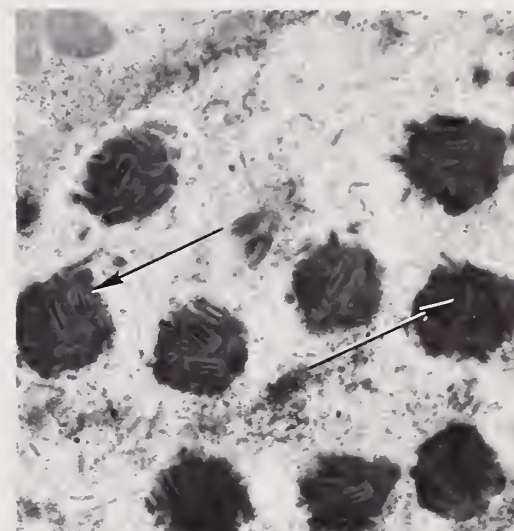
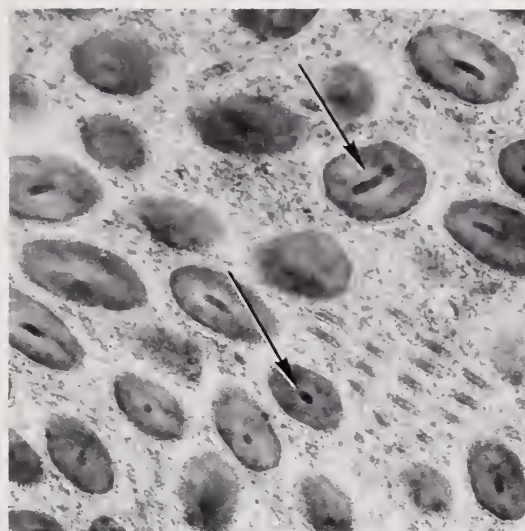
So far, viruses that have been isolated from these insects include:

**Almond moth nuclear polyhedrosis virus.** It attacks cell nuclei of the fat, hypodermis, and tracheae, and also develops in the blood cells, Malpighian tubules, part of the intestinal tract, nervous system, tissue associated with the reproductive organs and the anterior mid-gut.

Newly hatched almond moth larvae exposed to 8, 16, 32, and 64 x 10<sup>3</sup> of virus-bearing bodies called polyhedra per gram of bran diet suffered 18-, 22-, 48-, and 80-percent casualties, respectively.

**Almond moth granulosis virus.** It is highly virulent to almond moth larvae and can also infect the Indian meal moth. This virus attacks cytoplasm of the hypodermis, tracheae, and fat cells of the larvae.

**Webbing clothes moth nuclear polyhedrosis virus.** It attacks cell nuclei of the gut, ganglia of the ven-



*Left: Electron micrograph of an almond moth fat cell showing individual rod-shaped virus particles (arrows) lying inside the capsules (PN-2819). Right: This fat cell of the webbing clothes moth shows polyhedra in the nucleus. Packets of rod-shaped virus particles (arrows) are embedded within the polyhedra (PN-2820)*

## Turning the tide on insect pests

tral nerve cord, Malpighian tubules, tracheae, fat, hypodermis, muscle, and associated tissue of the moth larvae.

**Potato tuber moth granulosis virus.** It develops in the cytoplasm of hypodermis and fat cells of the moth larvae and, reportedly shows great promise for treating potato plants. Because of its ability to spread rapidly, one month after the virus was applied to two potato field plots, 92 percent of the fourth instar larvae in one plot, and 96 percent of the larvae in the second plot became diseased.

**Indian meal moth granulosis virus.** It occurs in the cytoplasm of cells of the hypodermis, tracheae, and fat. The ARS researchers exposed newly-hatched larvae to almonds sprayed with virus at the rate of 8 x 10,<sup>7</sup> 8 x 10,<sup>8</sup> 8 x 10,<sup>9</sup> and 8 x 10<sup>10</sup>

virus-containing capsules per 100 grams of almonds. Numbers of adults that emerged from the almonds showed that 63, 87, 98, and 97 percent, respectively, of the insects had been killed.

The economics of mass producing these viruses should be well within the realm of feasibility, as over one thousand infected host insects can be reared in a quart-size container. Treating stored products rather than field crops with pathogenic insect viruses offers advantages. In studying the virus effects and developing practical control uses, there is less risk of inactivating the viruses by high temperatures or ultraviolet light under storage conditions.

Although only viruses infecting the lepidopterous stored-product insects have been isolated and studied, Dr. Hunter believes that coleopterous pests will someday be added to this list. □



## Quiet fans remove fibers

A low noise, high efficiency centrifugal fan has been developed in the war against noise pollution.

The fan is a spin-off development of research at the Southern regional research laboratory, New Orleans, to improve means for removing textile fibers from a fiber processing cylinder.

Engineers Mayer Mayer, Jr., and James I. Kotter developed the doffer device, but the noise level was so high they decided to look into ways of reducing the noise level without reducing efficiency.

High speed centrifugal fans and blowers have always presented a noise problem. The noise, as engineers have long known, comes from turbulence created at an angle called the "cutoff" where the moving air changes direction from spiral flow to straight line flow.

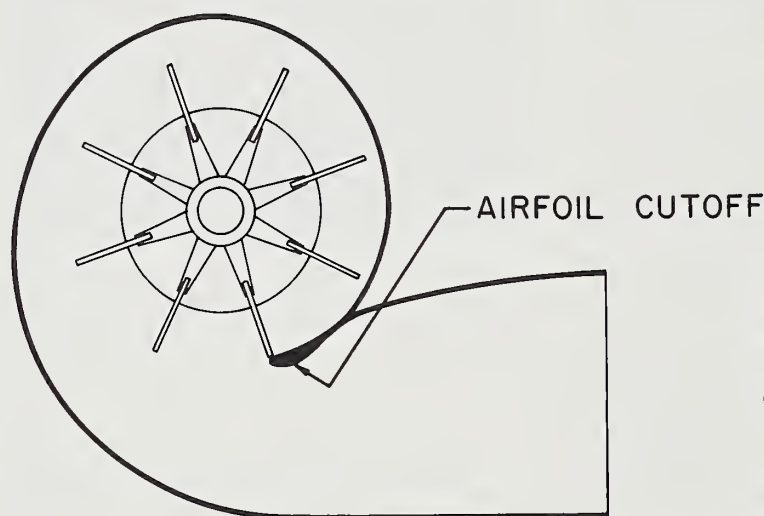
To reduce noise, engineers increase the clearance distance between fan blades and cutoff, but as the distance increases, efficiency decreases. Nor-

mally, the clearance should not be more than 7 percent of diameter of the fan. Beyond that point efficiency losses are drastic.

Engineers Mayer and Kotter, however, found that by changing the sharp angle of the cutoff to an airfoil with a smooth rounded leading edge, noise level can be reduced. The airfoil cutoff produces a smooth directional change

of airflow with minimum turbulence.

Investigations have demonstrated that for any given centrifugal fan, the airfoil-shaped cutoff can be set very close to the fan wheel to greatly increase efficiency while significantly decreasing the noise level. If extreme efficiency is not a factor, noise can be reduced to a very low level by using a combination of clearance and airfoil. □



*This schematic diagram of a centrifugal fan shows the airfoil cutoff which smooths out the flow of air as it changes direction from spiral flow to straight line flow. Normally the cutoff is a very sharp angle that causes noisy turbulences (PN-2821).*

## Water curbs weeds in rice

WATER-SEEDED culture for rice, combined with effective water management practices, should diminish problems with certain weeds and reduce or eliminate the need for some herbicide treatments.

Typically, rice in the South has been dry-planted—drilled into the soil much the same as wheat or oats—then flooded after the seedlings emerge. ARS agronomist Roy J. Smith, Jr., and research assistant William T. Fox of the Arkansas Agricultural Experiment Station, Stuttgart, evaluated the effects of planting rice and five weed species in flooded soil.

The scientists seeded Nova 66 rice and weeds—red rice, northern joint-vetch, hemp sesbania, barnyardgrass, and broadleaf signalgrass—at depths of

1/2, 1, 2, and 4 inches and at moisture conditions of field capacity (24-percent moisture), saturation (34 percent), or flooded to 1/2 and 2 inches. The number of emerged plants was counted 10 to 15 days after seeding; green plants were harvested and weighed 16 to 18 days after seeding.

Seeding depth and water management affected emergence of all plants. With moisture at either field capacity or saturation, all plants emerged well when seeded at 1/2, 1, and 2 inches. At the 4-inch planting depth, red rice emerged better than Nova 66. No plants emerged from planting depths of 2 and 4 inches in either of the flooded conditions.

Similarly, growth and weight of plants varied, but were considered ade-

quate with field capacity and saturation moisture, at planting depths of 1/2, 1, and 2 inches; growth was greatly reduced at these moisture conditions at the 4-inch planting depth. All plants failed to grow properly in the submerged conditions at all depths.

Scientists noted that emergence and growth of all the weed species were significantly reduced by continuous submergence of the soil, probably due to depletion of oxygen and presence of toxic substances. However, rice seeded in water, with seed placed on the soil surface, has been shown to germinate, grow, and yield satisfactorily. Since weed seed are distributed at various soil depths, only a limited percentage would be at depths conducive to emergence and growth. □



## Beef from bulls?

WITH better marbling, bulls could become the top choice of beef producers. Steers now hold an advantage in marbling, thus tend to grade higher than bulls. However, bulls gain faster and produce heavier carcasses with more lean meat than steers.

In experiments at the U.S. Meat Animal Research Center, Clay Center, Nebr., nutritionist Hudson A. Glimp compared the effects of various sex treatments on 60 Angus and 60 Hereford bulls. Treatments included two normal castration methods, two short-scrotum methods, and one Russian castration method of sex alteration. Intact males were also included in the tests.

The two normal castrations were conducted at birth and at weaning.

The two short-scrotum treatments included short scrotum at birth and short scrotum at weaning. Short-scrotum males are males in which the testicles are pushed up against the body and the scrotum removed with an elastrator.

Russian castration was performed at weaning. In this method, only the seminiferous tubules which convey the semen are removed. The rest of the reproductive organs are left intact.

Calves used in the study were weaned at approximately 200 days of age and were placed in a commercial feedlot for 210 additional days. They were slaughtered in a commercial packing plant and graded by USDA standards.

Both Angus and Hereford males responded similarly to the various sex treatments.

The tests indicated that there is no advantage in using short-scrotum males over bulls. Bulls and short-scrotum males had 12 to 15 percent more pounds of carcass protein and 14 to 15 percent less carcass fat than the castrates. The bulls and short-scrotum males also

gained faster, produced heavier carcasses, and had higher cutability than steers. However, because of a lack of marbling their meat did not grade as high as that of the steers.

A taste panel rated the tenderness of meat from castrates slightly above that of bulls or short-scrotum males. However, the panel rated meat flavor, juiciness, and overall appeal similar among all the test animals.

Research at other locations has shown that bull meat poses no problems as far as tenderness and overall acceptability are concerned, provided the bulls are under 15 months old when slaughtered.

Dr. Glimp sees real advantages in bull beef for both the producer and consumer. To give these advantages a better chance in the market, however, may require a change in present meat-grading standards, which favor the higher marbling of steer beef.

## Don't spoil the dates

TENDERIZED dried fruits found in supermarkets today are protected from microbial spoilage by a safe and simple antimicrobial treatment. Dates, however, are more difficult to preserve because of their relatively higher pH. Also, because consumers prefer soft dates, they are usually marketed at a moisture content favorable for growth of micro-organisms.

A unique antimicrobial treatment, which uses two preservatives instead of the conventional single chemical, has proven successful in recent California plant trials. The new process yields soft dates which retain their storage properties and delicate flavor.

The antimicrobial treatment was developed at ARS's Western regional research laboratory, Berkeley, Calif., by chemist Harold R. Bolin and microbiol-

ogist A. Douglas King, Jr.

The dates are dipped in a 2-percent solution of potassium sorbate and then exposed to methyl bromide, a gas. Test results show that methyl bromide fumigation after the dates have been packaged and cased for shipment is effective in reducing yeast and mold. Fumigation conditions and equipment used in these tests are similar to those used to control field insects on fruit after harvest.

If storage tests of the dates support the successful preliminary findings, several date processing plants in California are expected to convert their production lines to this new treatment procedure.

## Luring the codling moth

THE MYSTERY of how the female codling moth attracts her mate has been partially solved. A sex attractant, or pheromone, produced by the moth was chemically isolated, identified and synthesized—an achievement that may aid development of improved control methods against this pest.

Larvae of codling moths burrow into apples and are the most destructive pest of the Nation's apple crop. They also infest pears, English walnuts, and other pome and stone fruits throughout the world.

The pheromone's chemical code was cracked by a team of five ARS scientists: chemists Leslie M. McDonough and Donald A. George and entomologist Billy A. Butt at Yakima, Wash., and chemists John M. Ruth and Kenneth R. Hill at Beltsville, Md. Before synthesis, the compound, identified as 3-propyl-7-methyl-Z-2, E-6-decadien-1-ol, was isolated from extracts of female moths.

Apparently about seven different pheromones of the moth exist and the one identified is a major one of the





## AGRISEARCH NOTES

complex. Dr. McDonough and his associates at Yakima are attempting to further identify the other components.

Pheromones of only about 30 other species of insects have been identified, although hundreds of insect species are believed to produce them.

The substances can be used to bait insect traps which serve as survey tools for early detection of insect populations. Early detection helps insure success for control methods such as the release of sexually sterilized males. Pilot project releases of male codling moths sterilized by radiation are underway (AGR. RES., Aug. 1968, p. 8). Early and accurate detection of insect populations could also reduce the spraying of large areas that otherwise might require considerable insecticide.

The scientists found that natural and synthetic codling moth pheromones were both effective in attracting moths in tests using field cages. Each lure attracted 15 percent of the number of males attracted by traps that held 10 females per trap.

Scientists found the most effective amount of synthetic pheromone per trap was 10–15 micrograms. When more of the codling moth's pheromones are identified and synthesized, the attractiveness of the compounds may prove to be similar to that of live female insects.

## Long live the daisy

THE ONLY tetraploid Transvaal daisy reported in 80 years has been produced at the National Arboretum.

The Transvaal daisy (*Gerbera jamesonii*), introduced into this country from Africa in 1887, is also known as the Barberton daisy, African daisy, and Flameray Gerbera. Gerbera flowers are extensively used in the florist trade either as cut flowers alone or in flower arrangements. Although the Gerbera is increasing in importance to florists, no major research to improve the quality of the plant and flower has been done until now.

ARS horticulturist Robert L. Pryor of the National Arboretum, Washington, D.C., treated 48 Gerbera seeds with colchicine, a naturally occurring plant alkaloid often used to increase the chromosome number in plants. After an hour's colchicine treatment, the seeds were planted.

Of the 48 treated seeds, 42 germinated and were grown to flowering. Only one plant possessed larger flowers, a sturdier stem, and thicker leaves—characteristics of typical tetraploids. The ordinary Gerbera is a diploid; thus, the new tetraploid has twice the number of chromosomes in its cells. Mr. Pryor checked all major plant tis-

sues under the microscope to confirm its true tetraploid nature.

The new daisy produced seeds, and its seedlings also proved to be tetraploids. Thus, the line can be continued. Although tetraploidy has reduced flower production in some lilies and carnations, this does not occur with Gerbera.

Transvaal daisies come in varying colors. However, the tetraploid happens to be pink. The flower, which is about one-third larger than the normal flower, has much more substance in its petals. No seeds of the plant are available.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

